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(71) Applicant(s)
Kenneth Ian Fitzsimmonds
Kyrenia, Britons Lane, Beeston Regis, SHERINGHAM, Norfolk, NR26 8TR, United Kingdom

(72) Inventor(s)
Kenneth Ian Fitzsimmonds

(74) Agent and/or Address for Service
Kenneth Ian Fitzsimmonds
Kyrenia, Britons Lane, Beeston Regis, SHERINGHAM, Norfolk, NR26 8TR, United Kingdom

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(56) Documents Cited
GB 2109268 A GB 1578869 A GB 1449119 A
GB 1417528 A GB 1370990 A GB 1275845 A
US 4236902 A

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UK CL (Edition L) B1L LAE LAF LDB LDD LEA LEC, B1T TNAA TNRG TNRU, F1W WAB
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(54) System for obtaining oil-free compressed air

(57) Two items are included in the system, a conditioner and a processor, each of which can operate in its own right.

The conditioner device uses substances such as activated carbon to absorb or adsorb oil vapours and oil based odours. Air sucked into the compressor, passes through this device which may comprise twin cylinders separated by void B filled with carbon, or a sock, made of material impregnated with carbon, to be placed or stretched over the inlet to an air filter element. Alternatively, said element may itself be made of such impregnated material.

The processor device removes residual hydrocarbons from compressed air by catalytic conversion and it is fitted downstream of the compressor. Additionally the device shall convert any carbon monoxide which is present in the compressed air into carbon dioxide.

Heat exchangers (A, B, C, D, E, Fig. 4) may be incorporated in the system for compressing and cleaning air.

FIGURE 1

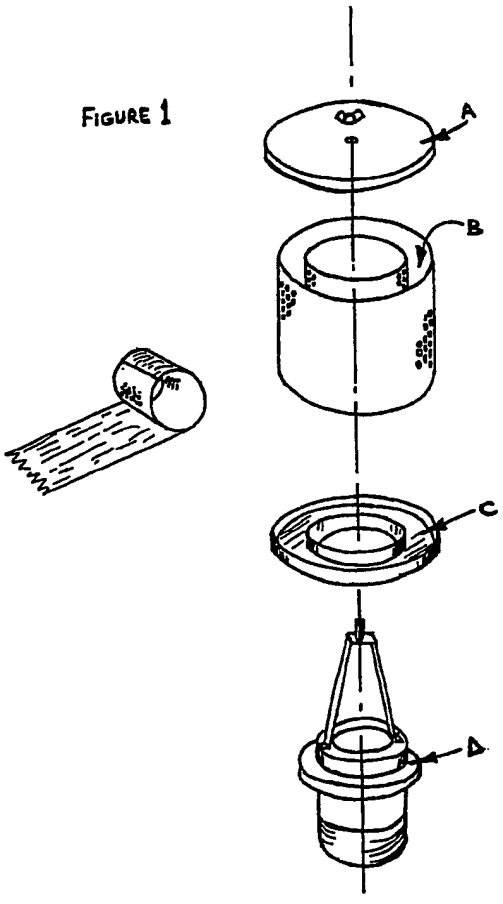

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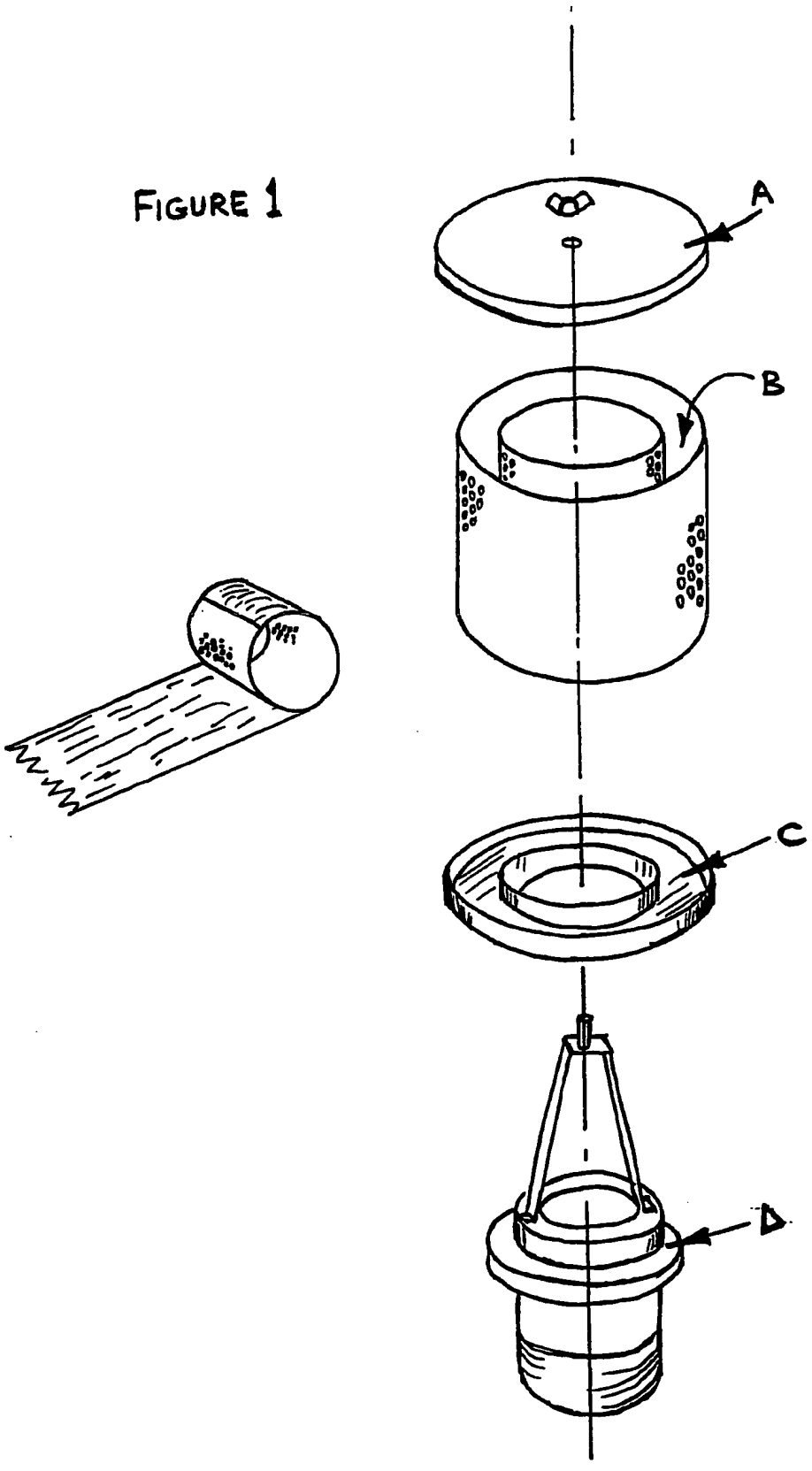
FIGURE 1



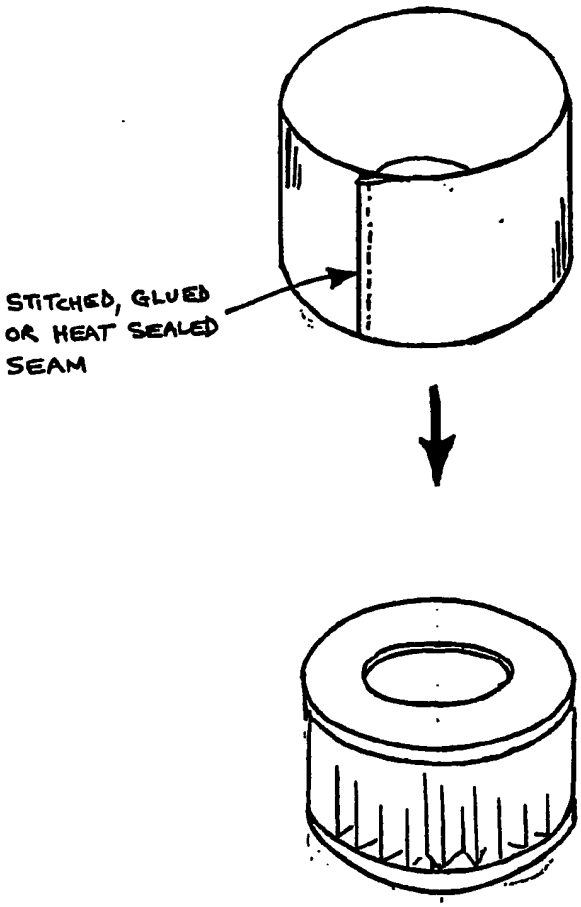


FIGURE 2

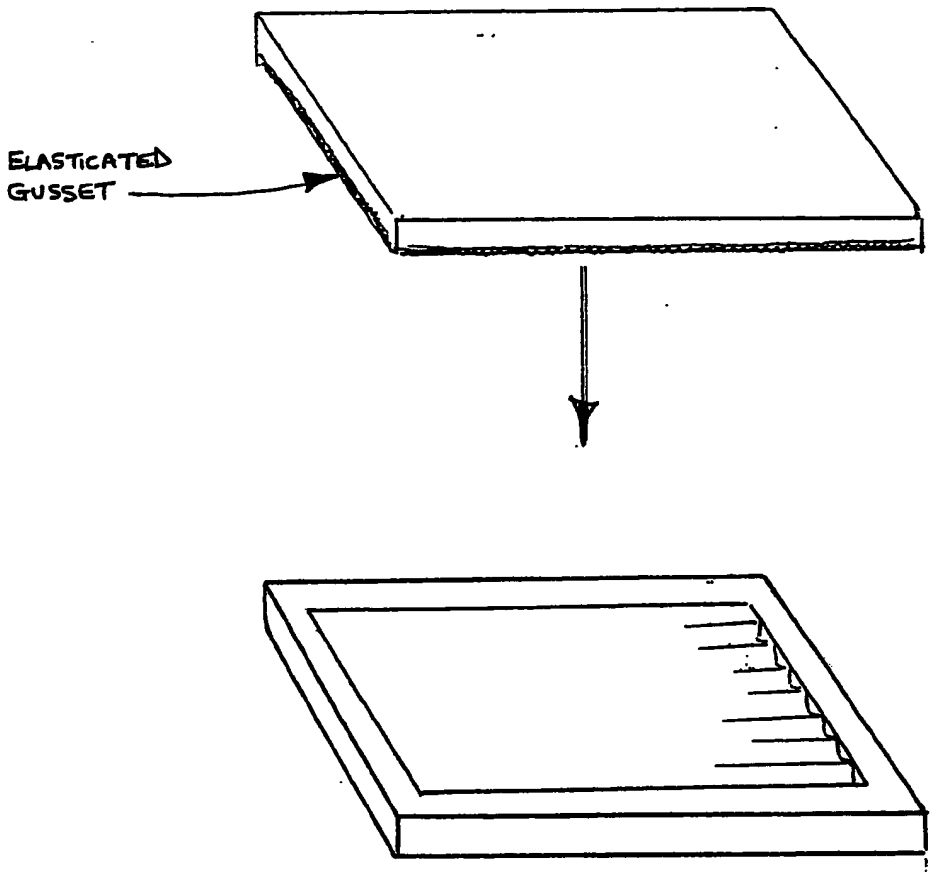


FIGURE 3

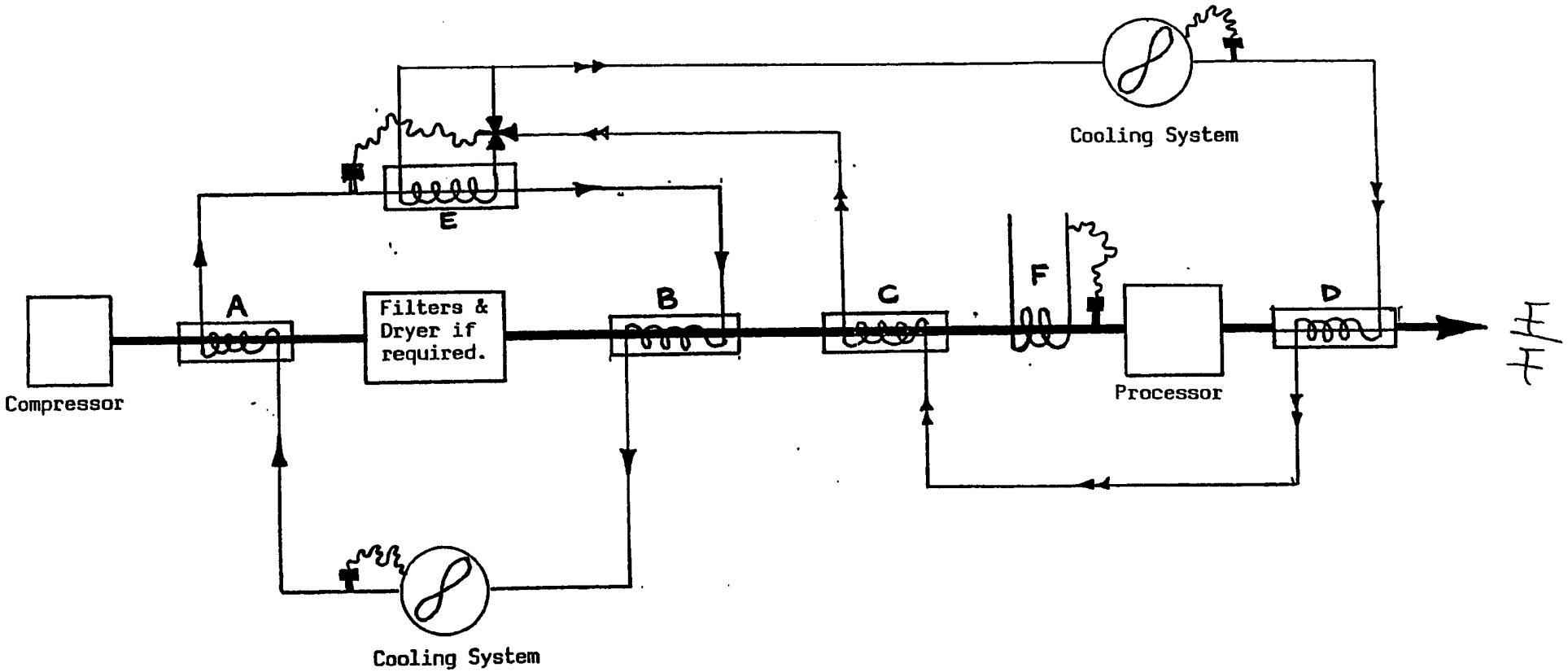

Cooling System
E
A
Filters &
Dryer if
required.
B
C
F
D
Compressor
Processor
Cooling System
Temperature sensor
Three way diverter valve

FIGURE 4

This invention ensures that compressed air shall be oil-free, whether the air is produced by an oil-free machine or a lubricated machine.

When air is being compressed, generally one of two groups of compressor is used although the types and variety of compressor within these groups are numerous. It should be noted that when the discharge pressure from the compressor is only in the order of 1.5 bar gauge or lower, then sometimes these low pressure compressors are termed blowers, or even fans when the discharge pressure is extremely low. This invention can be used for compressors, blowers, and fans of any discharge pressure and whenever the term compressor is used it implies and includes compressors, blowers and fans of all working pressures.

The first group are called Oil-Free compressors. These types of machine have by design a compression chamber or displacement chamber which does not contain any lubricating oil. Sometimes the compression chambers are water lubricated, sometimes they are coated with substances such as PTFE to reduce friction. Essentially this group of compressors will not add any further oil to the air which is sucked into them, however if a car or aeroplane has recently passed by, then the oil vapour and other hydrocarbon emmissions in the atmosphere will be sucked into the oil-free compressor. This contaminant is concentrated as the air is compressed and the result is compressed air from the Oil-Free Compressor which is contaminated with oil.

The second method is to use an Oil Lubricated compressor. It is usual with these machines to inject oil into the compression chambers either as a lubricant, or sometimes to flood the compression chamber with oil to absorb the heat of compression. This type of machine cannot produce oil-free compressed air unless the compressed air passes through a proprietory form of oil removal.

This invention can be used with either group of compressors, and shall ensure that the compressed air shall remain oil-free regardless of the hydrocarbon content of the surrounding atmosphere.

The invention consists of two items, one of which is installed on the inlet side of the compressor to remove oil vapours, the second of which shall be installed on the downstream side of the compressor to remove residual hydrocarbons and to convert any Carbon Monoxide into Carbon Dioxide. However, each individual item can be installed on its own, without the other, to greatly enhance the quality of the compressed air which is discharged from the compressor.

ITEM 1.
The first item is called a Conditioner, and it contains a substance which naturally absorbs oil vapours and oil odours, such as activated carbon. The atmospheric air is drawn through the Conditioner prior to entering the compressor itself. This shall ensure that any oil vapours/odours contained within the atmosphere are absorbed/adsorbed so that the atmospheric air which enters the compressor is of a greatly enhanced standard.

The Conditioner can be applied to the compressor in several forms, each of which has its own particular advantage. Figure 1 shows a Conditioner which utilises a twin perforated cylinder design. The perforated cylinders can be concentrically glued to component C or they can be left loose. The void area between the cylinders, marked B is filled with an oil vapour/odour absorbing material such as

activated carbon. To prevent the activated carbon falling out, the perforated cylinders would be wrapped with a suitable air permeable material such as rayon sheet or the like. Alternatively the activated carbon can be supplied in a pre-shaped bag or cartridge, which can be inserted into the void area. The top cover, marked A, is put in place and the wing nut secures it the the bottom assembly, marked D. When the activated carbon has reached the end of its service life the perforated cylinder assembly is removed and the old activated carbon disposed of, and new activated carbon inserted.

Figure 2 illustrates another form that the Conditioner can take. In this instance the Conditioner is supplied as a 'sock' manufactured using a material which shall be impregnated with activated carbon. The 'sock' is simply placed or stretched over a standard inlet air filter element, so providing an extremely low cost method for removing oil vapours and odours. The edges of the sock could be elasticated to form a gusset, for ease of fitting.

Figure 3 illustrates a pad type sock. This is used whenever air filters are rectangular or square. The principle is similar to that listed above which uses a circular sock, but in this instance the impregnated filter sock is stretched over, or stuck to, a rectangular or square filter element.

Another form that the Conditioner can take is to produce the inlet air filter element itself from a suitable filter material that has been impregnated with an oil vapour/odour removing substance such as activated carbon. In this instance the Conditioner shall replace the conventional air filter element and shall uniquely, carry out two simultaneous functions.

i. Firstly it shall perform the normal air filter duties by removal of particulate matter.
ii. Secondly it shall absorb/adsorb oil vapours and odours which would other-wise pass through the conventional inlet air filter element.

ITEM 2.
The second item is called a Processor and it contains a catalytic converter similar to the proprietory devices which are widely fitted to motor vehicles. This unit is fitted downstream of the compressor. The Processor is heated if necessary, using an external heat source which can in part be supplied by the heat of compression from the compressor itself, see Figure 4. The temperature of the air shall be raised, as necessary, prior to the compressed air passing through the catalyst. The action of the catalyst shall remove any residual oil vapours from the compressed air which passes through it. Additionally the Processor shall convert any Carbon Monoxide which is present within the compressed air to Carbon Dioxide. This is particularly important if the compressed air is to be used for breathing purposes.

Generally the heat of compression from an air compressor is wasted because this heat is classed as a useless byproduct. However, by installing a suitable heat exchanger, the heat of compression can be transferred to the Processor to increase the temperature of the compressed air as it passes through the Processor. By using multistage heat exchangers, the heat energy contained within the compressed air as it leaves the Processor can be recycled to heat up

the incoming air as it approaches the Processor. This greatly reduces overall running costs. Figure 4 shows a system which has two closed heat exchanger loops. The efficiency of the system can be increased by increasing the number of such loops.

The heat of compression is removed by heat exchanger A. This allows the compressed air to be treated by proprietory devices such as filters, dryers and the like, should the application require it. The inclusion of the filters, dryers etc is not fundamental to the principle of the Processor. The cooling medium passes through heat exchanger E and into heat exchanger B where it re-heats the compressed air as it leaves the filter/dryer system. The compressed air continues its path and passes through heat exchanger C to point F, where it receives an external heat source which is thermostatically controlled. The compressed air is now at the required temperature to pass through the Processor to have the residual hydrocarbons removed. When the air leaves the Processor it passes through heat exchanger D and the compressed air temperature is reduced. The heat recovered is passes to heat exchanger C where is shall increase the compressed air temperature, thus reducing the amount of external heat required from source F. The residual heat is passed to a three way thermostatic valve on heat exchanger E, and if the heat is usefull it shall pass through the exchanger, if it is less than the temperature of the cooling medium from heat exchanger A, it shall be diverted through a bypass pipe, back to the cooling system. Both loops contain a thermostatically controlled cooling system.

The nett result is compressed air which is to all intents and purposes oil free, even when the atmospheric air which surrounds the compressor is heavily laden with oil vapour or other hydrocarbon vapours.

CLAIMS

1. A Conditioner which removes atmospheric hydrocarbon vapours by use of substances such as activated carbon, so that atmospheric air drawn into an air compressor shall be greatly enhanced in quality. The substances can be fitted into the Conditioner as a loose fill, or by way of pre-formed bags, sacks or cartridges.
2. A Conditioner which may be constructed from a base material which has been impregranted with substances such as activated carbon. The conditioner shall be constructed in such a way that is can be placed over, in front of, or behind a proprietory filter, or filter assembly.
3. A Conditioner as described in claim 2, which uses an elastic type base material, so that the Conditioner can be stretched over a standard air filter element (or filter assembly). The Conditioner can be produced either with or without an elasticated gusset.
4. A Conditioner which is manufactured so that it can replace an ordinary filter element, the Conditioner may be pleated or otherwise. In addition to uniquely removing atmospheric hydrocarbon vapours it shall perform the same functions and duties as a standard filter element. The Conditioner shall be produced using base fabric or paper materials, supported to provide additional strength or otherwise, which shall be impregnated, coated or otherwise treated with substances such as activated carbon.
5. A Processor which contains a catalytic converter to remove hydrocarbon substances from compressed air.
6. A Processor which shall convert any Carbon Monoxide which is in the compressed air into Carbon Dioxide.
7. A Processor which is partially heated by incorporating a heat exchanger to utilise the heat of compression from the air compressor.
8. A Processor which shall have low running costs by incorporating a multi-stage heat exchanger. This shall ensure that high grade heat which is used in the catalytic conversion shall be recycled back to the approaching compressed air.

Pat nts Act 1977
Examiner's report to th Comptroller under ction 17 (The Search Report) 5

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R levant T chnical fields

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(ii) Int Cl (Edition 5) B01D, F04B

Search Examiner

MISS M M KELMAN

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

Date of Search

21 SEPTEMBER 1993

Documents considered relevant following a search in respect of claims 1 TO 4

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2109268 A (PROCESS SCIENTIFIC) see page 3, line 123 to page 4, line 12	1,2,4
X	GB 1578869 A (BAYER) see page 1, lines 75 to 78	1,2
X	GB 1449119 A (MARSHALL) see Figures 1 and 5	1,2
X	GB 1417528 A (SUZUKI) see Figure 2	1,2
X	GB 1370990 A (A B CENTRALSUG) see page 2, lines 21 to 27, and page 2 line 127 to page 3, line 127	1,2
X	GB 1275845 A (PORSCHE) see the Figures	1,2,4
X	US 4236902 A (FRICKE) see Figure 1	1,2

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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